

PARALLEL EVOLUTION OF FLORAL STRUCTURES IN
DARWINIA (MYRTACEAE) and *PIMELEA* (THYMELEACEAE)

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Darwinia and *Pimelea* are widespread genera throughout temperate Australia, and probably originated in this region. The families to which they belong, however, the Myrtaceae and Thymeleaceae, respectively, are considered only distantly related (Hutchison, 1969 and Takhtajan, 1969),

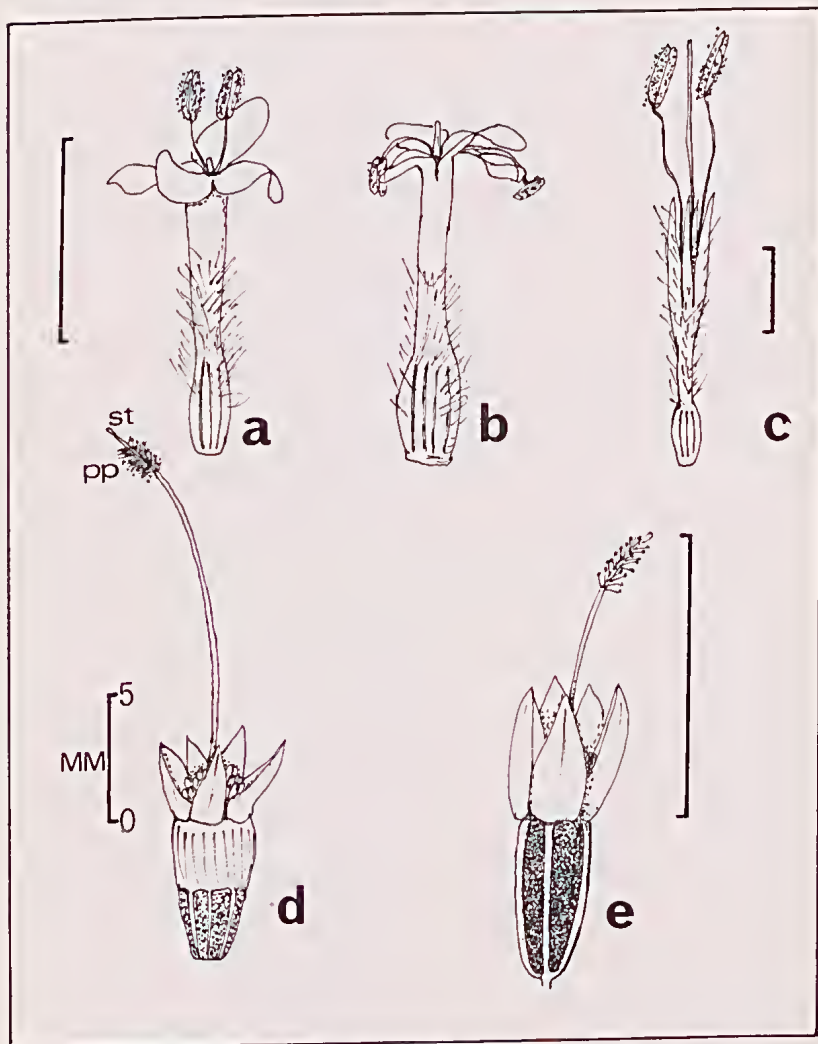


Fig. 1—Single Flowers.

Fig. 1a—*Pimelea rosea*—anther discharging.

Fig. 1b—*Pimelea rosea*—stigma receptive.

Fig. 1c—*Pimelea physodes*.

Fig. 1d—*Darwinia macrostegia*.

Fig. 1e—*Darwinia vestita*.

pp—pollen presenter st—stigma

although Cronquist (1968) has placed them in the same order, the Myrtales, but in different sections.

Naturally the basic inflorescence and floral structure shows this lack of relationship (see Fig. 1, a-c and Fig. 2, c and d). The flowers of *Pimelea* have four perianth parts, with four or two anthers per flower, while *Darwinia* has five perianth parts and numerous anthers per flower. Reasons for the divergent inflorescence organization will be offered later.

Both genera show extreme protandry, but in remarkably different ways. In most species of *Pimelea*, the anthers dehisce, then fall, being re-

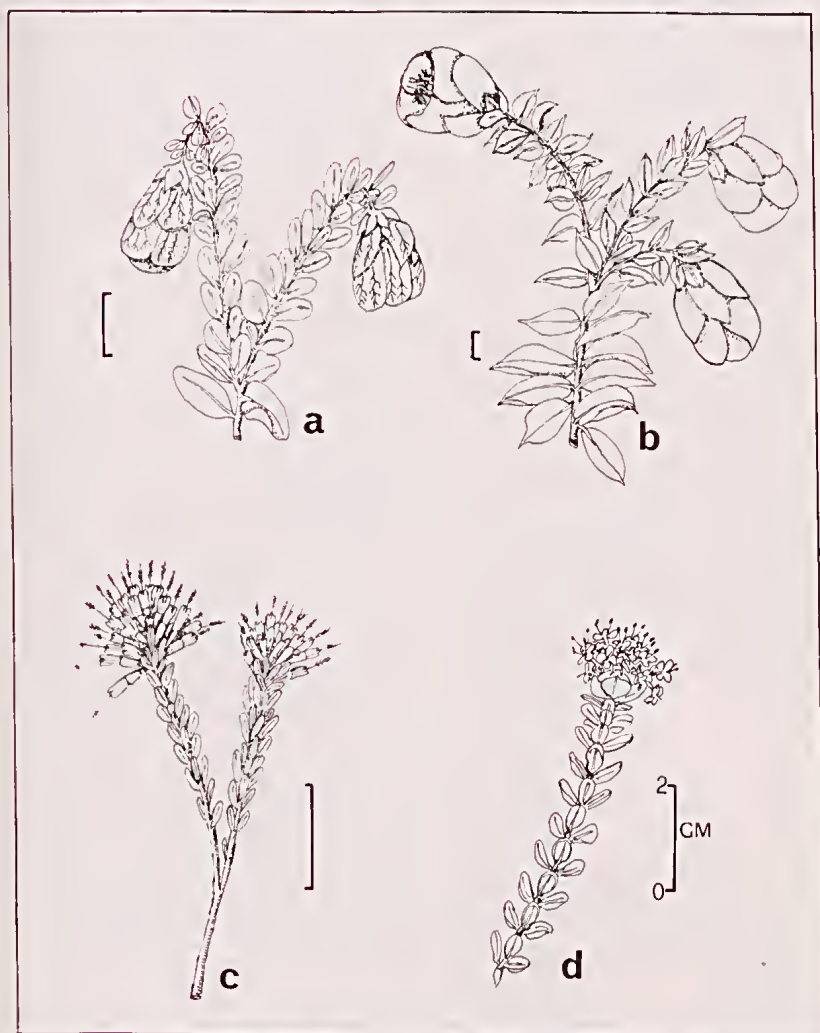


Fig. 2.—Inflorescence Morphology.

Fig. 2a—*Darwinia macrostegia*.

Fig. 2b—*Pimelea physodes*.

Fig. 2c—*Darwinia vestita*.

Fig. 2d—*Pimelea rosea*.

(a, b and c from herbarium material)

placed by a receptive stigma (Fig 1, a and b). In *Darwinia*, the anthers dehisce in the bud and extrude their pollen suspended in an oily liquid onto a pollen presenter located near the tip of the style (Fig 1, d and e). As the bud opens the style is extended and the pollen becomes available for dispersal, at a later date the stigma becomes receptive.

Morcombe (1968, 1970) has indicated that butterflies are the probable major vectors of *Pimelea*, and my personal observations fully support his hypothesis (Table 3). The long tubular corolla of *Pimelea* is ideally suited to such a vector, as is the open nature of the inflorescence (Fig 2, d).

Generally, *Darwinia* has been found to be bird pollinated in Eastern Australia, in studies by Brewster (1915) and Briggs (1962, 1964). Briggs (1964) does indicate that some of the smaller species are also visited by insects. Many western species of the genus are also bird pollinated, see Tables 1 and 2. These species generally have large showy bracts surrounding the inflorescence (Fig 2, a; and also illustrations in Gardner, 1968), and a long style to deposit pollen on the visitors' head (Fig 1, d). Most of these species have the pollen presenter situated below the apex where the stigma is located and will not self although all species studied are self fertile (Briggs, 1964). However some species with round floral heads, e.g. *D. nielandia*, have the stigmatic head covered by the pollen presenter and can self. These species apparently form a distinct group in the bird pollinated species.

The other group of species of *Darwinia* in Western Australia have insignificant bracts and small white flowers (Fig 1, c and Fig 2, c) and are pollinated by insects; see Tables 1 and 2. All species in this group are able to effect self pollination.

One species of *Pimelea*, *P. physodes* Hook, has long caused considerable comment because of its external similarity to *Darwinia macrostegia* (Good, 1956 and Hutchison, 1969). This similarity has been noted as an extremely unusual example of parallel evolution that could not be ex-

TABLE 1.—POLLINATION VECTORS OF *DARWINIA* SPP IN WESTERN AUSTRALIA.

| Species | Area | Vectors observed |
|-----------------------|-------------------------------|--|
| <i>D. speciosa</i> | Hill River | <i>Lichmera indistincta</i> * <i>Gliciphila melanops</i> * |
| <i>D. macrostegia</i> | Slopes of Mt. Toolbrunup | <i>Acanthorhynchus supercilliosus</i> * |
| <i>D. nielandia</i> | Eneabba to Jurien Bay Road | <i>Acanthochaera chrysoptera</i> * <i>Phyllidonyris niger</i> * |
| <i>D. citriodora</i> | Darlington | <i>Acanthorhynchus supercilliosus</i> * |
| <i>D. thymoides</i> | Chittering | Thinnidae (flower wasps) Native Bees |
| <i>D. vestita</i> | 7 miles west Mt. Barker | Thinnidae (flower wasps) Native Bees |
| <i>D. diosmoides</i> | Two Peoples Bay | Thinnidae (flower wasps), <i>Exoneura</i> sp. (Bee) |
| <i>D. pauciflora</i> | Mullewa | Thinnidae (flower wasps) |

*Birds

TABLE 2.—POLLINATION TYPES IN WESTERN AUSTRALIAN *DARWINIAS*.

| Large showy bracts- birds | Small bracts- insects | Uncertain |
|------------------------------|--------------------------|----------------------|
| <i>D. pimelioides</i> | <i>D. thymoides</i> | <i>D. acerosa</i> |
| <i>D. speciosa</i> | <i>D. vestita</i> | <i>D. oederoides</i> |
| <i>D. carnea</i> | <i>D. repens</i> | <i>D. oldfieldii</i> |
| <i>D. macrostegia</i> | <i>D. pauciflora</i> | <i>D. virescens</i> |
| <i>D. hypericifolia</i> | <i>D. polycephala</i> | <i>D. purpurea</i> |
| <i>D. helichrysoides</i> | <i>D. rhadinophylla</i> | <i>D. sanguinea</i> |
| <i>D. meisneri</i> | <i>D. diosmoides</i> | |
| <i>D. meeboldii</i> | <i>D. pinifolia</i> | |
| <i>D. collina</i> | <i>D. verticordina</i> | |
| <i>D. squarrosa</i> | | |
| <i>D. nielandia</i> | | |
| <i>D. citriodora</i> | | |
| 12 species | 9 species | 6 species |

TABLE 3.—POLLINATION VECTORS OF *PIMELEA*
O, denotes original

| Species | Area | Source | Vector* |
|------------------------|------------------------------------|-------------------|--------------------------------------|
| <i>P. sulphurea</i> | Cockleshell Gully | Original | <i>Canadalides acastus</i> |
| <i>P. sulphurea</i> | Yanchep | O | <i>Vanessa kershawi</i> |
| | | | <i>Vanessa itea</i> |
| <i>P. ferruginea</i> | Yanchep | O | <i>Vanessa kershawi</i> |
| | | | <i>Vanessa itea</i> |
| | | | <i>Taractrocera papyria</i> |
| | | | <i>Canadalides</i> |
| | | | <i>hyacinthinus</i> |
| <i>P. rosea</i> | Darlington | O | <i>Vanessa itea</i> |
| | | | <i>Vanessa kershawi</i> |
| | | | <i>Danaus chryssipus</i> |
| | | | <i>petilia</i> |
| <i>P. spectabilis</i> | Mount | O | <i>Heteronympha merope</i> |
| | Chudalup | | <i>duboulayi</i> |
| <i>P. spectabilis</i> | 30 miles north | O | <i>Heteronympha merope</i> |
| | Pemberton | | <i>duboulayi</i> |
| <i>P. suaveolens</i> | Darlington | | <i>Vanessa itea</i> |
| <i>P. sylvestris</i> | Shannon River | O | unident. butterfly |
| <i>P. augustifolia</i> | Walpole | O | unident. butterfly |
| <i>P. sp.</i> | Stirlings | O | <i>Neolucia agricola</i> |
| <i>P. sp.</i> | Stirlings | O | <i>Heteronympha merope</i> |
| | | | <i>duboulayi</i> |
| <i>P. haemostachya</i> | Frazer, Burdekin River, Qld. | Morcombe, 1970 | <i>Anaphels java</i> |
| <i>P. physodes</i> | Fitzgerald River Reserve | O | <i>Gliciphila melanops</i> (bird) |
| <i>P. sp.</i> | Black Mountain, Canberra | O | unident. butterfly |
| <i>P. sp.</i> | Woy Woy, N.S.W. | Rayment, 1935 | <i>Halictus urbanus</i> Sm. (bee) |

*all butterflies unless stated

plained (see Fig 2, b) by usual methods. As noted, however, in Table 1, the author has found this species to be bird pollinated. The radically different flower with its long style and anthers (Fig. 1, c) ensures effective placement and pick-up of pollen with this new vector. The large bracts serve an attractant function as in the bird pollinated species of *Darwinia*.

The range of *P. physodes* borders that of large numbers of bird pollinated *Darwinias* which grow in the Stirling Ranges, where over 20 species of honeyeater are found. It would appear, therefore, that such mimicry must be of adaptive advantage to the species, especially as it flowers during the middle of the year when most honey plants are not in flower (including most species of *Darwinia*). The species thus provides an abundant nectar source for the honeyeaters when few are available.

SUMMARY

The 'parallel' evolution shown by *Pimelea physodes* is shown to be of adaptive value in utilizing a new vector source, not able to be used by other members of the genus. Its occurrence near the greatest concentration of bird pollinated *Darwinia* species of similar morphology suggests a form of mimicry may be operating. This species, because of these adaptations, now forms a distinct group in the genus *Pimelea*.

Further study upon the pollination systems of our species of *Darwinia* is needed to erect an evolutionary sequence of morphological change in this genus.

REFERENCES

- BREWSTER, A. A., 1915. Observations on the pollination of *Darwinia fascicularis*. Rudge (N. O. Myrtaceae). *Proc. Linn. Soc. N.S.W.*, 40: 753-758.
- BRIGGS, B. G., 1962. The New South Wales species of *Darwinia*. *Contrib. N.S.W. Nat. Herb.*, 3: 129-150.
- BRIGGS, B. G., 1964. The control of interspecific hybridization in *Darwinia*. *Evoln.*, 18: 292-303.

- CRONQUIST, A., 1968. *The Evolution and Classification of Flowering Plants*. Nelson and Sons, London.
- GARDNER, C. A., 1968. *Wildflowers of Western Australia*. Ed. H. F. Parkinson, West. Aust. Newspapers, Perth.
- GOOD, R., 1956. *Features of Evolution in the Flowering Plants*. Longmans, Green and Co., London.
- HUTCHISON, J., 1969. *Evolution and Phylogeny of Flowering Plants*. Acad. Press, London.
- MORCOMBE, M., 1969. *Australia's Western Wildflowers*. Landfall Press, Perth.
- MORCOMBE, M., 1970. *Australia's Wildflowers*. Lansdowne Press, Sydney.
- RAYMENT, T., 1935. *A Cluster of Bees*. Endeavour, Sydney.
- TAKHATAJAN, A., 1969. *Flowering Plants, Origin and Dispersal*. Oliver and Boyd, Edinburgh.

SOME FIELD OBSERVATIONS ON *NUYTSIA FLORIBUNDA* (LABILL.) R.BR.

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INTRODUCTION

All authors describing the aspects and peculiarities of the Western Australian flora mention the monotypic *Nuytsia floribunda* and point to its peculiar appearance; for example in the recent works of Morcombe (1968), Seddon (1972) and Erickson (1973) and others. The authors usually mention the following characteristics:

- (1) *Nuytsia* is one of the three genera of the family of Loranthaceae rooting in the ground. The second genus which is also found in Australia, *Atkinsonia*, is also monotypic; the third, *Gaiadendron*, contains a few species in South America.
- (2) The abundance and magnificence of its blossoms, blooming from December until the middle of January and especially copious after forest fires.
- (3) The arborescence and size which is unique among the Loranthaceae.
- (4) The secondary bend of the boughs related to the development of more than one cambium ring.
- (5) The growth of very long root-runners which produce the root-suckers thereby providing for the vegetative propagation of the plant. (Regeneration by means of seeds seems to be exceptional).

Beyond these there are only very few specific studies of *Nuytsia*. Herbert (1918) was the first to find out that it is a root parasite. Diels (1906) doubted its parasitism; because in some cases he could not find any suitable host plants within a considerable distance around the plant. He writes: "It would be—at least for the full-grown state of the tree—a very forced assumption, if one imagined that it takes its nutrition from the roots of those comparatively dwarf shrubs thriving scantily at its feet." Grass, later discovered as a possible host by Herbert, was not even taken into consideration.

Further descriptions of the parasitism of *Nuytsia* are to be found in Ewart's (1930) study; he writes that carrot root crops are parasitized. McKee (1952) found the roots of neighbour plants parasitized. Main (1947) presents a study in which he draws attention to the poor germinative faculty of *Nuytsia* seeds and the difficulties of artificial propagation. Narayana (1955, 1958) worked on the morphology of the blossom and the embryology. Beyond these only a few scattered remarks are to be found

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